

Spot Safety Project Evaluation

Project Log # 200712064

Spot Safety Project # 05-99-219

**Spot Safety Project Evaluation of the Traffic Signal Installation
And Left Turn Lane Installation on the NC 42 Approaches
At the Intersection of NC 42 and SR 1006 (Old Stage Rd)
Wake County, near Fuquay Varina**

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Traffic Engineering and Safety Systems Branch
North Carolina Department of Transportation

Principal Investigator

Jason B. Schronce

1-23-2008
Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 05-99-219 – The Intersection of NC 42 and SR 1006 (Old Stage Road) in Wake County.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of a 2-phase, actuated traffic signal and left turn lane installation on the NC 42 approaches. In the study period, NC 42 and SR 1006 (Old Stage Road) were both two-lane, two-way facilities at the subject intersection with no turn lanes and speed limits of 45 mph. The subject location is a four-leg crossroads style intersection, which was controlled by a four-way stop condition during the before period.

The original statement of problem was the excessive delay caused by the four-way stop. Angle and rear-end collisions were also occurring because of congestion. The intersection met signal warrants 1, 9, and 11.

The initial crash analysis was completed from April 1, 1996 to March 31, 1999 with eighteen (18) reported crashes, nine (9) of which were Angle Crashes. The final completion date for the improvement at the subject intersection was on May 13, 2002 with a total cost of \$140,000.00.

Naive Before and After Analysis

After reviewing the spot safety project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period was from April 1, 2002 to June 30, 2002. The before period consisted of reported crashes from February 1, 1997 through March 31, 2002 (5 years and 2 months) and the after period consisted of reported crashes from July 1, 2002 through August 31, 2007 (5 years and 2 months). The ending date for this analysis was determined by the date of available data at the time of analysis.

The treatment data consisted of all crashes within 150 feet of the subject intersection. *Please see attached location map, aerial map, and photos for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Frontal Impact Crashes were the target crashes for the applied countermeasure. The Frontal Impact Crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Right turn, same roadway; Right turn, different roadways; Head on; and Angle. Rear-end collisions concerning the left turn lane installation on NC 42 could not be analyzed independently since all approaches were required to stop at the four-way stop control in the before period analysis.

<u>Treatment Information</u>			
	Before	After	Percent Reduction (-) Percent Increase (+)
Total crashes	21	20	- 4.76 %
Total Severity Index	3.47	9.97	187.32 %
Target Crashes	15	8	- 46.67 %
Target Crash Severity Index	3.47	16.03	200+ %
Volume	11,740	13,940	18.74 %
<u>Injury Crash Summary – Total</u>			
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	0	1	100.00 %
Class B injury Crashes	0	3	200+ %
Class C Injury Crashes	7	11	57.14 %
Total Injury Crashes	7	15	114.29 %

The naive before and after analysis at the treatment location resulted in a 5 percent decrease in Total Crashes, a 47 percent decrease in Target Crashes, but a 187 percent increase in the Total Severity Index. The before period ADT year was 1999 and the after period ADT year was 2005.

Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 5 percent decrease in Total Crashes and a 47 percent decrease in Target Crashes. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have decreased at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, a large portion of crashes at the intersection in the before period (12 of 21) were angle collisions resulting from improper use of the four-way stop or a stop sign violation. After the signal installation, this pattern was significantly reduced to just three (3), which were the result of one southbound SR 1006 vehicle and two eastbound vehicles on NC 42 running the red light. The severity of the after period collisions more than tripled from the before period due in part to high speed angle collisions.

There was a slight decrease in Rear-End Crashes at the intersection (from 5 to 3) after the countermeasures were installed. The remaining frontal impact collisions in the after period developed in the form of Left Turn; Same Roadway collisions. The dominant pattern being southbound SR 1006 vehicles attempting to turn left onto eastbound NC 42 in which all four collisions resulted in an injury. Over all, injury crashes doubled at this intersection during the after period.

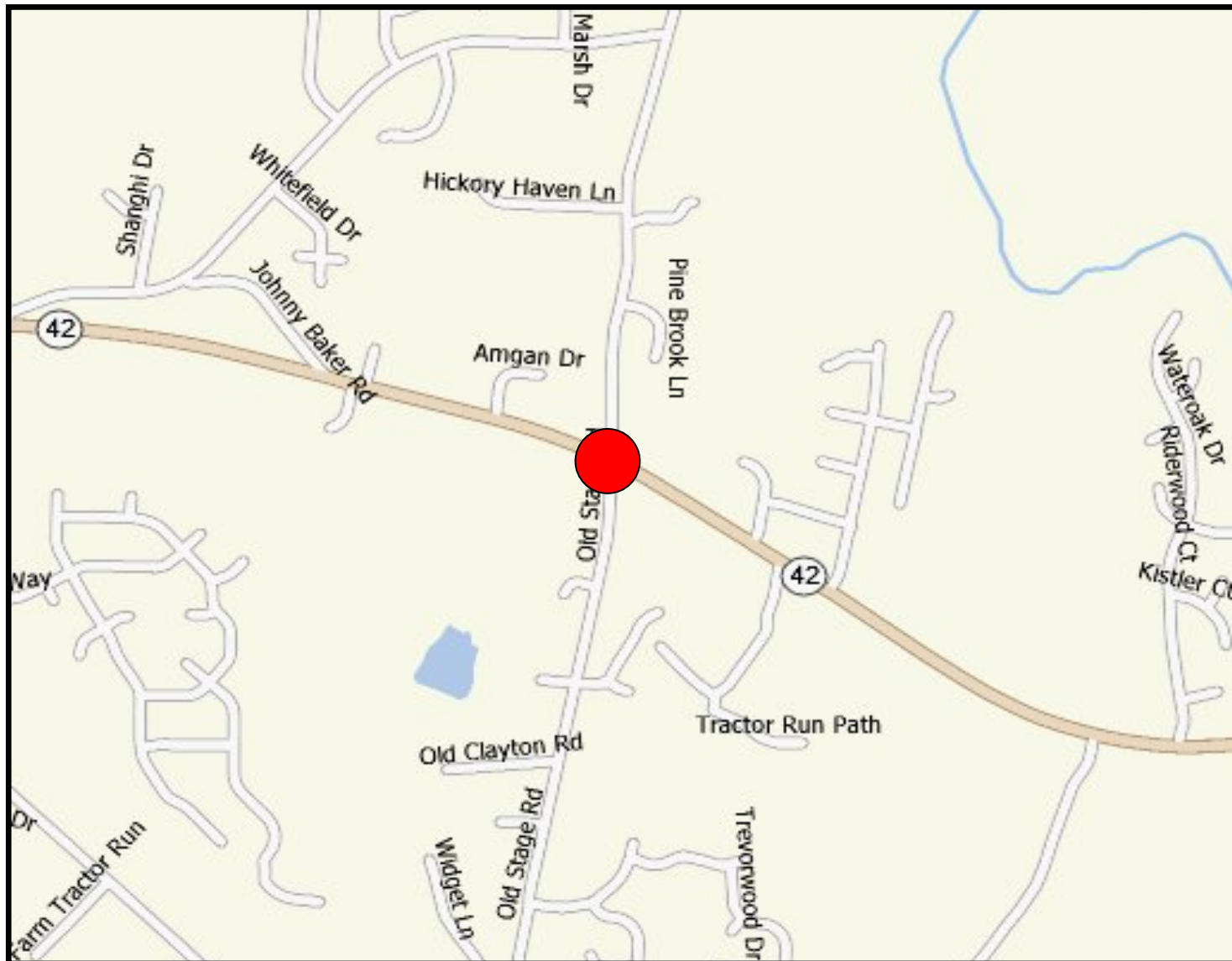
The calculated benefit to cost ratio for this project is -4.74 considering total crashes. The benefit to cost ratio considering only target crashes is -3.87. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and other benefits related to the

project are not considered in this analysis. The costs of the project include the actual construction costs as well as the increase in annual maintenance and utility costs. A negative B-C ratio in this instance results from an increased severity from the before to the after period crash data.

Please see the attached *Treatment Site Photos*. Photos taken on January 16, 2008 are provided for all approaches to the treatment intersection. A photo is also provided showing steep roadway shoulder drop-off from northbound SR 1006 into the gravel lot of former Lawrence Garage PVA. This is not of great concern given that this parking lot is not frequently accessed currently.

As the Safety Evaluation Group completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors for this type of intersection.

**Location Map
Wake County
Evaluation of Spot Safety Project # 05-99-219**



Treatment Location: NC-42 at SR 1006 (Old Stage Road), Near Fuquay Varina

**SS# 05-99-219 Aerial Map
Wake County**



TREATMENT SITE PHOTOS TAKEN 1/16/2008



Traveling East on NC 42



Traveling West on NC 42 (Notice grade change into intersection)



Traveling North on SR 1006 (Old Stage Road)



Traveling South on SR 1006 – Intersection visibly blocked due to grade



Traveling South on SR 1006 (Old Stage Rd)



Steep Shoulder drop-off in Northwest quadrant on SR 1006
Gravel lot of former Lawrence Garage PVA

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: NC 42 at SR 1006
COUNTY: Wake
FILE NO.: SS 05-99-219

BY: JBS
DATE: 1/22/2008
NOTES: Total Crashes

DETAILED COST: TYPE IMPROVEMENT - New Signal and Left Turn Lanes on NC 42 Approaches

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$140,000	10	0.149	\$20,864
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$140,000	10	0.149	\$20,864

ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$2,400
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$900
TOTAL ANNUAL COST=	\$24,164
TOTAL COST OF PROJECT=	\$140,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	5.16	0	0.00	7	1.36	14	2.71	\$35,000
AFTER	5.16	1	0.19	14	2.71	5	0.97	\$149,516

Annual Benefits from Crash Cost Savings (\$114,516)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$138,680)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -4.74

TOTAL COST OF PROJECT - \$140,000 COMPREHENSIVE B/C RATIO - -4.74

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: NC 42 at SR 1006

BY: JBS

COUNTY: Wake

DATE: 1/22/2008

FILE NO.: SS 05-99-219

NOTES: Target Crashes - Frontal Impact

DETAILED COST: TYPE IMPROVEMENT - New Signal and Left Turn Lanes on NC 42 Approaches

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$140,000	10	0.149	\$20,864
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0

TOTALS	\$140,000	10	0.149	\$20,864
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ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$2,400
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$900
TOTAL ANNUAL COST=	\$24,164
TOTAL COST OF PROJECT=	\$140,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

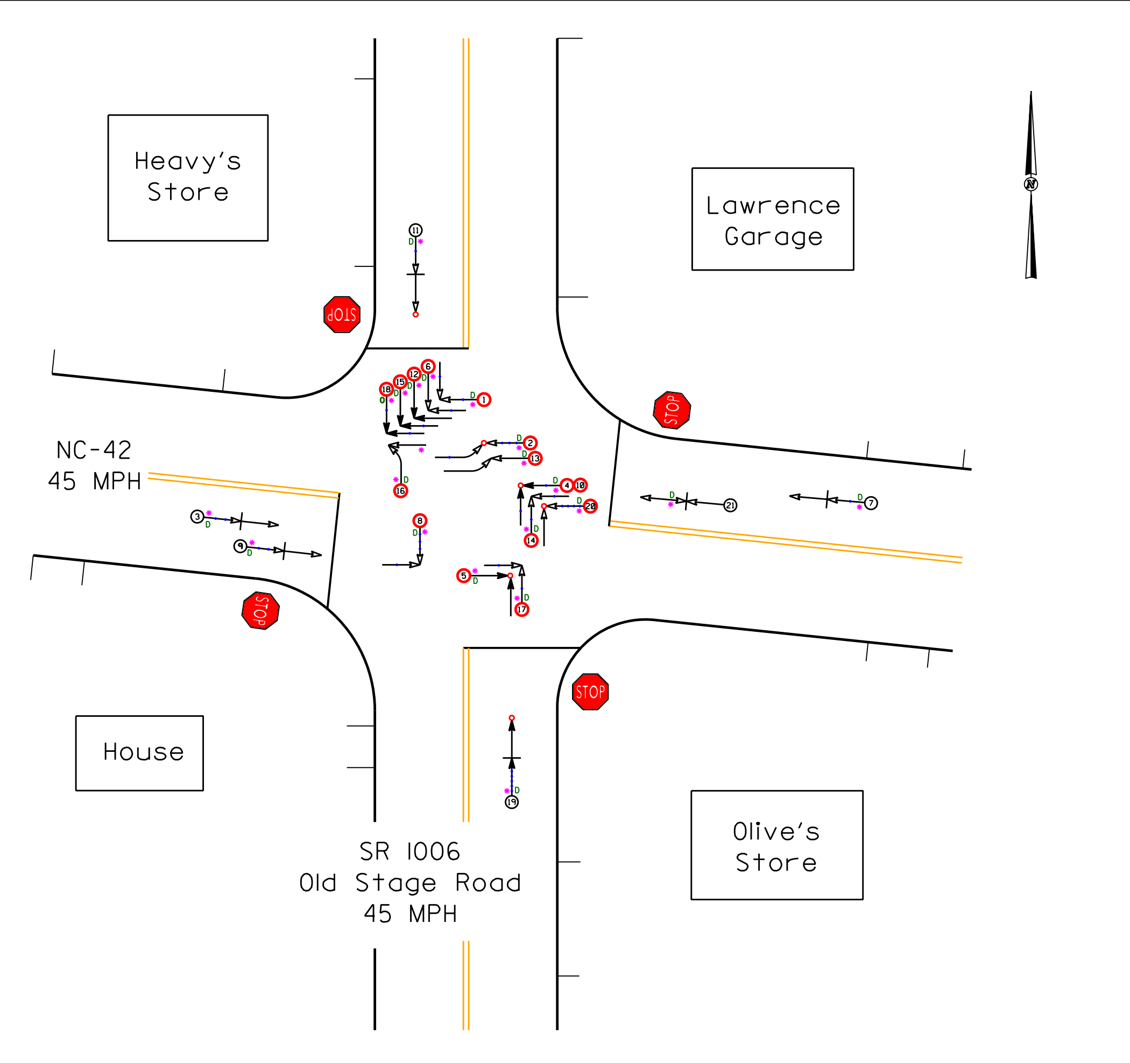
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	5.16	0	0.00	5	0.97	10	1.94	\$25,000
AFTER	5.16	1	0.19	6	1.16	1	0.19	\$118,585

Annual Benefits from Crash Cost Savings (\$93,585)
































NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$117,749)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -3.87

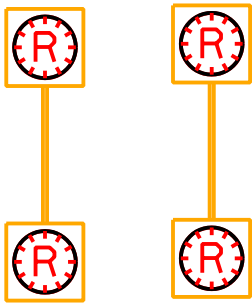
TOTAL COST OF PROJECT	-	\$140,000	COMPREHENSIVE B/C RATIO	-	-3.87
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LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PARKED VEHICLE		BACKING		20 MPH TO 29		DRIVER AT FAULT
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		DRY
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		WET
	HEAD ON		INJURY		50 MPH TO 59		ICY OR SNOWY
	REAR END		FATALITY		60 MPH TO 69		SPEED UNKNOWN
	RAN OFF ROAD				70 AND UP		ONLY

SS# 05-99-219
Wake County
BEFORE Period
2/1/97 - 3/31/02
NC-42 at SR 1006



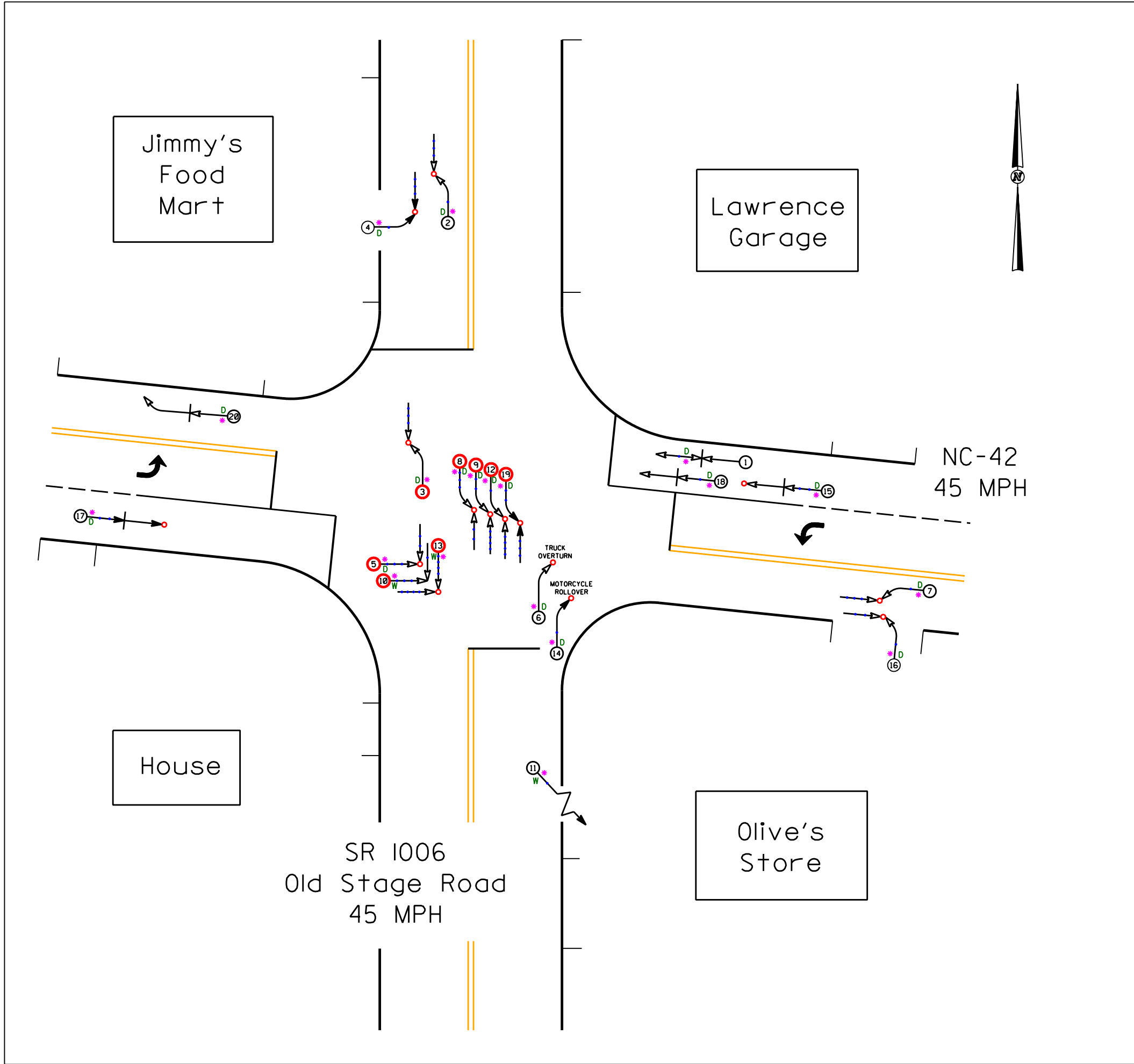
Intersection Controlled
with 4-way Stop
and Flashers

Target Crashes
Frontal Impact

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 5	AREA:
STUDY PERIOD: 2/1/1997 TO 3/31/2002	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: JBS	
ANALYSIS CHECKED BY: BR	
DIAGRAM PREPARED BY: JBS	
DIAGRAM REVIEWED BY: ST	
SCALE: NOT TO SCALE	
DATE: 1-10-2008	
LOG NUMBER: SS* 05-99-219	

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH



LEGEND					
	MOVING VEHICLE		ANGLE		9 MPH OR LESS
	PEDESTRIAN		TURNING		10 MPH TO 19
	PARKED VEHICLE		BACKING		20 MPH TO 29
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49
	HEAD ON		INJURY		50 MPH TO 59
	REAR END		FATALITY		60 MPH TO 69
	RAN OFF ROAD		SPEED UNKNOWN		70 AND UP
					P PEDESTRIAN
					T TRAIN
					• DRIVER AT FAULT
					D DRY
					W WET
					I ICY OR SNOWY
					O ONLY

SS# 05-99-219
Wake County
AFTER Period
7/1/02 - 8/31/07
NC-42 at SR 1006



New Signalized Intersection

⊕ Target Crashes
Frontal Impact

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 5	AREA:
STUDY PERIOD: 7/1/2002 TO 8/31/2007	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: JBS	
ANALYSIS CHECKED BY: BR	
DIAGRAM PREPARED BY: JBS	
DIAGRAM REVIEWED BY: ST	
SCALE: NOT TO SCALE	
DATE: 1-10-2008	
LOG NUMBER: SS# 05-99-219	

N.C. DEPARTMENT of TRANSPORTATION
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TRAFFIC ENGINEERING AND SAFETY
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